Asymptotic Approach Algorithm

Robert H. Francis, P.E.
Senior Project Engineer
Chr. Hansen, Inc.
New Berlin, WI 53151

KEYWORDS

Process Control Algorithm, Batch Control

ABSTRACT

The asymptotic approach algorithm is a time-domain feedback type process controller utilizing a properly tuned polynomial equation to calculate the controller output. Its applications include those where the process variable must quickly move to and operate at the process setpoint without exceeding that setpoint (overshoot). The error (setpoint – process variable) is mathematically operated on by a polynomial equation. The result is the process measurement approaches the setpoint by following a polynomial curve. For applications requiring setpoint maintenance; a modified integral function is included to ensure the process variable is held at the setpoint over time.

INTRODUCTION

In batch process control applications, it is usually necessary to rapidly move the process variable to a setpoint but not allow that process variable to overshoot (or undershoot) the setpoint (i). Batch cycle times are reduced by minimizing the time required to move the process variable to the setpoint.

In some processes, process quality may be damaged if the process variable exceeds setpoint. In other processes, such as exothermic, unsafe conditions can occur with process variable overshoot. This process operation has two contradictory functions: to rapidly change the process variable when the process variable is far from the setpoint and to slowly change that variable when near the setpoint (ii)(iii)(iv). This is done with the final control element at 100 percent until the process variable is within a few units of the setpoint at which time the final control element rapidly moves to 0 percent.

A number of control strategies have been use to for this application, including: Proportional-Integral-Derivative (PID), Ramp-Soak, and Model Based controllers. Unfortunately, each of these controllers has drawbacks in trying to meet the above goals: inefficient response, no safeguards against overshoot, or significant complexity.

© Instrument Society of America 2001